UNPUBLISHED
SURVEY & CONTROL
REPORTS

INTERMOUNTAIN STATION
Central Reference File
No. 3.4153-11

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Project Date June 23, 1952 Author

TITLE

NATURAL WEEVIL MORTALITY IN PINE SPECIES HYBRIDS AND PONDEROSA PINE STRAINS

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SUBJECT—

INDEX NO.—

U. S. GOVERNMENT PRINTING OFFICE 16—47272-1

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IN PINE SPECIES HYBRIDS AND PONDEROSA PINE STRAINS

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NATURAL WEEVIL MORTALITY

IN PINE SPECIES HYBRIDS AND PONDEROSA PINE STRAINS

During the past few years, John M. Miller conducted many studies of the resistance of pine species and species hybrids to the pine reproduction weevil, Cylindrocopturus eatoni Buch. Most of these studies were made by forcing weevil attacks on the trees which were to be tested, but in addition to such tests Miller noted during the late summer of 1949 that many of the trees in the 1946 nursery at the Institute of Forest Genetics were dying from a natural weevil infestation. He decided then to let the weevil infestation run its course for the next two seasons to see if there was a preferential selection of some progenies over others. Miller made annual mortality counts in this nursery in 1950 and 1951 before the new adult weevils had emerged in the spring.

Mortality in Ponderosa Pine Geographical Strains

The seven beds in which the mortality was occurring had been planted on a randomized plan to obtain a comparison of the early growth behavior of eitht regional strains of ponderosa pine, Pinus ponderosa Laws. The trees which were included in these tests were obtained from pollinations of two local ponderosa pines (Eldorado Co.) with pollen obtained from trees growing in the arboretum at the Institute. These trees originally had been obtained from the following localities: British Columbia; Chelan, Washington; Bitterroot, Montana; Monument Nursery, Colorado; Josephine County, Oregon; Crater Lake, Oregon; and Santa Cruz County, California. Wind-pollinated seed from one of the Eldorado trees also was included in the planting. When this study was started in 1949 all of the trees were in their fourth year of growth and were becoming badly overcrowded as a result of the 6" x 6" spacing between trees in the nursery beds.

The results of Miller's mortality counts are given in Table 1. In this table top-killed trees have not been included in the annual mortality. Table 2 summarizes the data from Table 1 by pollen sources and seed sources.

An analysis of variance has been made from this data by R. C. Hall (Table 3). It shows that the variation in the mortality in the progeny from different seed sources is very highly significant, but that there is no significant difference in the mortality of the progeny from the pollen sources as a group. However, when a chi-square test is made of the mortality in the progenies from each of the regional pollen sources used in pollinating the two seed trees (Table 4), it is obvious that the progeny from the seeds fertilized with pollen from Josephine County, Oregon is significantly more resistant than nearly all of the other progenies. In a similar test using only one seed tree but more pollen sources (Table 5) the wind-pollinated progenies from the Eldorado seed

tree is significantly better than the progenies of all of the other regions except Josephine County, Oregon, Monument Nursery, Colorado, and Bitterroot, Montana. This would indicate that pollen from certain regeions could be used most successfully in producing weevil resistant planting stock, except for the fact that individual tree differences may play a more important role in progeny resistance than does the provenience of the parents.

The results of this study indicate to a certain extent that the weevil resistance of individual trees is a function of the provenience of the pollen or seed parents. However, they indicate more conclusively that, regardless of the geographic origin of the stock, the resistance is inherited from the individual pollen or seed parents themselves and that the parents are extremely variable in their resistance. Further investigations of the resistance of individual trees and the inheritance of resistance are being conducted to study this finding. If individual trees show the great range of inherent resistance which this study indicates, then it should be possible to select comparatively resistant trees for use as commercial seed sources or for use in breeding superior trees.

Although the terms "resistance and susceptibility" are used rather freely in this report, it should be noted that at the present time it is impossible to determine whether the low percent mortality which occurs in some cases is the result of the inherited resistance of the progenies or whether it results from a selection by the weevils of certain "susceptible" progenies.

In any future studies that are made of weevil resistance, particular emphasis should be placed on determining whether all individuals have been attacked equally and at random. This would greatly facilitate the resolution of this problem of inherent host resistance vs. host selection. Nevertheless, regardless of which condition prevails, it remains significant that the progenies of certain seed trees and certain pollen sources do survive better than others under conditions of natural selection and attack by weevil populations.

Mortality in Pine Species Hybrids

In addition to the study discussed above, observations were made of the 1950 mortality in different species hybrids and wind-pollinated individuals from corresponding seed parents. The results of these observations are presented in Table 6, and further substantiated Miller's earlier opinion that the Jeffrey pine backcross of the Jeffrey-Coulter hybrid is more resistant than the wind-pollinated Jeffrey pine itself. The mortality in experiment number 20 also indicates that the ponderosa-Apache hybrid may be somewhat more susceptible to the weevil than wind-pollinated ponderosa pine. This might be readily suspected from the very susceptible nature of wind-pollinated Apache pine.

MORTALITY CAUSED BY CYLINDROCOPTURUS EATONI IN STRAINS OF PONDEROSA PINE

1946 Nursery - Institute of Forest Genetics

TABLE NO. 1

Exp. No.	Species	Living 1948	Top-Killed by Weevil 1949	Top-Killed by Weevil 1950	Killed by Weevil 1949 Trees	Killed by Weevil 1949 %	Killed by Weevil 1950 Trees	Killed by Weevil 1950 %	Total Killed 1949-1950 Trees	Total Killed 1949-1950 %
21	P-Eld-4B-56 X PP-Wash.	97			29	29	8	11	37	38.2
	" X Wind	97			19	19	5	6.1	24	24.7
23	P-Eld-4B-56 X PP-Wash.	84			19	23	3	4.6	22	26.2
	PP-Chelan N.F. X Wind	87	2	1	23	26	16	25	39	44.8
24	P-Eld-4B-56 X PP-Mont.	93	3	3	12	13	2	2.4	14	15.1
	PP-Bitterroot X Wind	22	2	1	12	55	8	72.7	20	90.9
25	P-Eld-4B-56 X PP-Mont.	64		1	27	42	2	5.4	29	45.3
	P-Eld-4B-56 X Wind	77	3	3	15	19			15	19.5
26	P-Eld-4B X PP-Pac. Coast	95	4		15	15	26	28	41	43.2
	" X Wind	99			2	2	20	20.6	22	22.2
27	P-Eld-4B-56 X PP-Ore.-Cra.	80		1	8	10	25	35	33	41.2
	" X Wind	95			7	7	16	18.4	23	24.2
28	P-Eld-4B-56 X PP-Br. Col.	98	4	2	15	15	33	39.3	48	49.0
	" X Wind	100	3	3	8	8	23	25	31	31.0
29	P-Eld-4B-56 X PP-Ore.-Jos.	95			3	3	29	31.2	32	33.7
	" X Wind	96			1	1	25	26.3	26	27.1
31	P-Eld-15-43 X PP-Ore.-Jos.	97					2	2	2	2.1
	PP-Ore.-Mix X Wind	61					2	3	2	3.3
32	P-Eld-15-43 X PP-Wash.	64			1	2	13	26	15	21.9
	PP-Chelan X Wind	85			5	6	28	35	33	38.8
22	P-Eld-4B-56 X pollen from									
	8 sources:									
	PP-Wash.	38			16	42	2	9.1	18	47.3
	PP-Mont.	40		1	11	28	1	3.4	12	30.0
	PP-Br. Col.	39			10	25	2	6.6	12	30.8
	Wind	39			10	26	1	3.4	11	28.2
	PP-Ore.-Cra.	40	2	2	10	25			10	25.0
	PP-Bitterroot	40		1	11	28	2	6.6	13	32.5
	PP-Pac. Coast	40			11	28	3	10.3	14	35.0
	PP-Ore. Jos.	38			12	30			12	31.6
30	P-Eld-15-43 X pollen from									
	5 sources:									
	Montana	39							0	0.0
	Ore-Jos.	39					1	2.5	1	2.6
	Wash.	34							0	0.0
	Br. Col.	40	1	1	1	3	3	7.7	4	10.0
	Ore.-Cra.	39	1	1	1	3	3	7.7	3	7.7

TABLE NO. 2 - SUMMARY OF MORTALITY BY POLLEN SOURCE AND SEED SOURCE OF TREES

POLLEN SOURCE	SEED SOURCE								
	P-Eld 4B-56			P-Eld. 15-43			Combined		
	Living	Dead	% Mort.	Living	Dead	% Mort.	Living	Dead	% Mort.
British Columbia	137	60	43.8	40	4	10.0	177	64	36.1
Washington	219	77	35.1	98	14	14.3	317	91	28.7
Josephine Co., Ore.	133	44	33.1	136	3	2.2	269	47	17.5
Crater Lake, Ore.	120	43	35.8	39	3	7.7	159	46	28.9
Monument, Colo.	197	55	27.9	39	0	0.0	236	55	25.6
Bitterroot, Mont.	40	13	32.5						
Eldorado Co., Cal.	603	152	25.2						
Santa Cruz Co., Cal.	135	55	40.7						

TABLE NO. 3 - ANALYSIS OF VARIANCE OF THE MORTALITY IN TREES FROM DIFFERENT SEED AND POLLEN SOURCES

Source of Variation	DF	SS	Mean Square	F	Significance
TOTAL	9	2268.93			
Between pollen sources	4	219.97	54.99	4.7	None
Between seed sources	1	2002.23	2002.23	171.	Very high
Interaction (error)	4	46.73	11.70		

MILLERS FALLS
CANADIAN SKIN
REPRODUCTION

TABLE NO. 4 - X^2 ANALYSIS OF THE SIGNIFICANCE 1/ OF MORTALITY DIFFERENCES BETWEEN POLLEN SOURCES USED ON TWO SEED TREES

Pollen Source	British Columbia	Washington	Josephine Oregon	Crater Lake Oregon	Monument Colo.
British Columbia	-------				
Washington	N S	-------			
Josephine, Ore.	V H S	H S	-------		
Crater Lake, Ore.	N S	N S	H S	-------	
Monument, Colo.	S	N S	N S	N S	-------

1/ N S = Not a significant difference

S = Significant difference

H S = Highly significant difference

V H S = Very highly significant difference

TABLE NO. 5 - x^2 ANALYSIS OF THE SIGNIFICANCE 1/ OF MORTALITY DIFFERENCES BETWEEN POLLEN SOURCES USED ON ONE TREE (P-ELD 4B-56)

Pollen Source	B.C.	Wash.	Jos. Ore.	C. Lake Ore.	Mont.	Colo.	Bitterroot Mont.	Eldo. Co. Cal.	Sta. Cruz Co., Cal.
British Columbia	----								
Washington	N S	----							
Josephine Co., Ore.	N S	N S	----						
Crater Lake, Ore.	N S	N S	N S	----					
Monument, Colo.	S	N S	N S	N S	----				
Bitterroot, Mont.	N S	N S	N S	N S	N S		----		
Eldorado Co., Cal.	H S	S	N S	S	N S		N S	----	
Santa Cruz Co., Cal.	N S	N S	N S	N S	N S		N S	H S	----

1/ N S = Not a significant difference
S = Significant difference
H S = Highly significant difference
V H S = Very highly significant difference

MORTALITY CAUSED BY CYLINDROCOPTURUS RATONI IN STRAINS OF PONDEROSA PINE

1946 Nursery - Institute of Forest Genetics

TABLE NO. 6

Exp. No.	Species	Living 1949	Killed by Weevil 1949 Trees	Killed by Weevil 1949 %	Killed by Weevil 1950 Trees	Killed by Weevil 1950 %	Total Killed 1949-1950 Trees 1/	Total Killed 1949-1950 %
11	PJ-Eld-1-14 X (PJ X Cl)	195			1	.5	1	0.5
	" X Wind	208			9	4.2	9	4.3
12	PJ-Eld-1-14 X (PJ X Cl)	111			3	2.7	3	2.7
	" X Wind	127			36	27	36	35.3
13	PJ-Eld-5-3 X (PJ X Cl)	66			0	0	0	0.0
	" X Wind	88			5	5.6	5	5.7
20	P-Eld-12-1 X PAp-Mix ('44)	29			4	16	4	13.8
	" X Wind	38			1	2.7	1	2.6

1/ Does not include top kills